

## Review of zinc-based hybrid flow batteries: From fundamentals to applications

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### ABSTRACT

Zinc-based hybrid flow batteries are one of the most promising systems for medium- to large-scale energy storage applications, with particular advantages in terms of cost, cell voltage and energy density. Several of these systems are amongst the few flow battery chemistries that have been scaled up and commercialized. The existing zinc-based systems rely on zinc electrodeposition in flowing electrolytes as the negative electrode reaction, which is coupled with organic or inorganic positive active species in either solid, liquid or gaseous phases. These reactions are facilitated with specific cell architectures under certain circumstances. To improve the performance and cycle life of these batteries, this review provides fundamental information on zinc electrodeposition and summarizes recent developments in the relevant flow battery chemistries, along with recent applications. The future challenges and opportunities for this technology are discussed.

### KEYWORDS:

Applications; Electrodeposition; Plating; Redox flow batteries; Zinc